Tennessee Smallmouth Bass Management Plan

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Foreword

The purpose of this plan is to identify the Tennessee Wildlife Resources Agency (TWRA)'s goals, objectives, and strategies for the management of smallmouth bass and its fisheries in the state of Tennessee. The plan will provide a foundation for annual recommendations to the Tennessee Wildlife Resources Commission and define realistic management goals given the variability in productivity of waters across Tennessee.

Throughout this document we address two resource categories, streams and reservoirs. To clarify, streams refer to all the streams, creeks, and rivers that are free-flowing, as well as a few that are affected by dam discharges yet still behave more like rivers than impoundments (e.g. Pigeon River, Duck River). Reservoirs are the impounded reaches of river upstream of dams. This includes tributary impoundments such as Dale Hollow Lake, and mainstem impoundments, like Kentucky Lake. Tailwater areas of mainstem reservoirs are considered reservoir areas (e.g. Pickwick tailwater). Besides their hydrologic differences, streams and reservoirs warrant separate attention because of marked differences in smallmouth bass populations and their fisheries.

The plan includes some fisheries terms that warranted clarification. If you are not familiar with fisheries jargon, then it may help to read the glossary on page 15 before reading the plan.

Acknowledgements

This plan is based on field survey data collected by TWRA fisheries biologists across the state. Their contributions provided the biological foundation for this plan. TWRA biologists also reviewed the plan, especially Rick Bivens, Bart Carter, John Riddle, and Todd St. John.

Public comment was obtained from members of Tennessee's bass fishing community (Appendix A). We would like to thank the 43 individuals that took the time to share their thoughts on our management plan. Their support and criticisms were considered in preparing this final draft.

Current Status

Smallmouth Bass Populations

In Tennessee, smallmouth bass are common throughout their native range of the Tennessee and Cumberland river watersheds (Figure 1). They inhabit medium to fast moving streams, rivers and reservoirs with good water clarity. Western Tennessee, particularly the Mississippi basin, is not part of the smallmouth bass's native range, nor have smallmouth bass populations ever been established.

A recent survey by TWRA biologists reported the characteristics of the Tennessee smallmouth bass populations in streams (Fiss et al. 2001). Many of the populations surveyed had a low abundance of quality-size bass. The average proportional stock density was 34, meaning that only 34 percent of the stock length fish (over 7 inches) in the population were over 11 inches long (PSD=34). According to other researchers (Anderson and Weithman 1978) given the levels of mortality and growth, the PSD for Tennessee populations should be from 40 to 70. This suggests that there may be opportunities to improve smallmouth bass populations size structures using regulations. Reservoir populations typically have higher proportions of larger fish, however signs of high mortality for larger fish have been observed.

The best opportunities to improve riverine bass populations using regulations occur in populations with low natural mortality (< 30 %) and fishing mortality that exceeds 20 % (Fiss et al. 2001). Mortality rates for riverine smallmouth bass populations surveyed ranged from 15 to 55 %, averaging 39 %, but it is not known how much of this mortality is due to fishing. Reservoir populations experience total annual mortality rates ranging between 40 % and 60 %. Natural mortality is presumed low due to the more stable environment in reservoirs.

In streams, smallmouth bass can live to be 15 years of age, and attain a maximum length of about 21 inches. The average stream smallmouth bass grows to 14 inches in length by age 6 (Figure 2). In reservoirs the average smallmouth bass reaches 14 inches in 4 years (Figure 2).

Smallmouth bass are found in nearly all of Tennessee's reservoirs, however substantial populations have only developed in those reservoirs that have clear, cool water habitats (Figure 3). In some reservoirs this habitat is limited to the lower and middle sections of the reservoir, and the distribution of smallmouth bass can be essentially limited to these areas. The more fertile mainstem reservoirs of Tennessee and Cumberland rivers have experienced cyclic "booms" of smallmouth bass fishing when discharge is low and water clarity increased.

Smallmouth Bass Fishery

Fishing Regulations **-** The statewide regulation for bass (all black bass in combination) is 5 fish per day, with no size restrictions. The objective of this regulation was to distribute harvest among more anglers. This regulation applies to all streams in Tennessee, except for the Pigeon River and Little Pigeon River in east Tennessee.

Reservoir populations are managed through a variety of length restrictions; many tied in

combination with largemouth bass limits of 14 or 15 inches. These minimum length limits are based largely on growth rates and the length of fish at age 3, and are particularly appropriate when smallmouth bass are a relatively low proportion of the overall black bass population. Higher length limits of 18 inches (Nickajack, Norris, Watts Bar and Chickamauga reservoirs) and 20 inches (Douglas Reservoir) are aimed at protecting low-density populations with fast growth rates with the goal of protecting fish to larger sizes. High recruitment systems with the potential to grow trophy-sized fish are candidates for PLRs (slot limits). Dale Hollow Reservoir currently has a 16-21 inch PLR and allows 2 fish per day with only one above 21 inches.

Anglers - From 1995 through 2000 the University of Tennessee used phone surveys to ask residents of Tennessee a variety of questions about fishing in Tennessee (Jakus et al. 1998, 1999; Stephens et al. 2001) (Table 1). The average angler in these surveys fished streams about 9 times each season. About 40 % of these anglers targeted black bass, catching about 4 bass per trip and harvesting about 0.4 bass per trip. Thirty-two percent of reservoir anglers reported targeting smallmouth bass during the 2000 survey period; second behind targeted effort for largemouth bass (45 % of anglers reported targeting). Reservoir anglers fished an average of 15 reservoir trips per season and reported an average catch of 2 smallmouth bass per trip. Harvests were the same as in streams at 0.4 fish taken home per trip.

The U.T. survey also asked stream anglers about their support of regulations for bass on streams (Table 1). Over the 4 year period, 68 % of the anglers said they would support length limits for stream bass. Of those that supported length limits, a majority of the anglers preferred a 12-inch size limit (mean 41 %), followed closely by a 14-inch limit (mean 37 %). Two-thirds of the anglers supported slot limits. Reservoir anglers were asked if they supported current TWRA harvest restrictions. Eighty-one percent supported current regulations and only 3 % of those who opposed current regulation said they felt that smallmouth bass were over-regulated.

Although we have statewide estimates for the number of trips per year and harvest rates, we do not know how this effort is distributed across the state. On the Duck River a 7-month creel survey reported relatively low fishing pressure (~5,500 trips, resulting in the harvest of only 700 black bass species on this 150 mile reach on the river (Condo and Bettoli 2000). In contrast, anglers made 7,500 trips to a 5.2-mile reach of the North Fork of the Holston River and harvested 713 smallmouth bass during an 8-month period (Bettoli 2002). Surveys conducted on smaller streams in middle Tennessee in 2001 provided the only recent estimates of fishing activity on smaller streams (Cleveland et al. 2002). On Big Swan Creek and East Fork Mulberry Creek there were 1,384 and 684 trips, respectively, over a 12-week period. On Big Swan Creek an estimated 338 smallmouth bass were harvested during a 12-week period, while on East Fork Mulberry Creek too few were harvested to allow an estimate to be calculated. Fishing activity and harvest rates vary across the state. If we can determine where the highest harvest rates are occurring, we can identify areas where we can improve the fishing by regulations.

Reservoir populations of smallmouth bass currently sustain much higher annual angler catch and harvest rates than riverine populations. Catch and harvest on Dale Hollow Reservoir alone were estimated at 106,228 and 12,227 respectively during 2001 (Malvestuto and Black 2002). Reservoir creel surveys are conducted annually and provide TWRA with a clear picture of how

smallmouth bass fishing effort is distributed among reservoirs, and how fishing regulations are affecting the catch. Reservoir managers monitor angler harvest rates and recruitment patterns to provide harvest regulations that maintain fish density and quality (size structure) of catch.

Habitat

Smallmouth bass inhabit medium to fast flowing, coolwater streams with good water clarity. Like all of Tennessee's fishes, the major threats to riverine smallmouth bass are poor water quality and limited quantity. While much abated in recent decades, point-source pollution from industrial and municipal wastewater sites still routinely contaminate streams. Also, non-point pollution in the form of silt, chemicals, and nutrients contributed by improper agricultural, domestic, and construction practices, and urban sprawl are currently impacting smallmouth bass habitat. Loss of riparian habitat is still rampant in Tennessee and this loss will not only increase sedimentation, but will also increase stream temperatures due to a lack of shade. Another source of pollutants and warm water is rapid run off from impervious surfaces such as large parking lots. Demands for a limited water supply in some areas has resulted in increased water withdraw from rivers or new impoundments for storage; both scenarios have decreased the availability of smallmouth bass habitat in rivers and streams.

Many of the above issues affect reservoir smallmouth bass habitat to a lesser extent. However, watershed conditions do have effects on reservoir populations as tributaries and spawning shoals can become silted in and suspended sediment can decrease water clarity. High nutrient loads increase reservoir productivity that may limit the success of smallmouth bass. Loss of physical structure used for cover and spawning as reservoirs age is also a factor that may also affect smallmouth bass populations and angler success.

Perhaps the biggest factor affecting smallmouth bass recruitment in Tennessee impoundments is water level stability. Although little research has been conducted on what affects recruitment in reservoirs, low water levels during the pre-spawn period and instability of water levels during spawn have shown detrimental affects for the other reservoir sport fish species. Increased water demands as our human population increases may result in longer draw-down periods and increased water level instability acting in direct competition with the needs of reservoir smallmouth bass.

Goal

Our goal is to maintain and improve the smallmouth bass fisheries in Tennessee. To attain this goal TWRA will strive to meet the following management objectives.

Primary Objectives

- Improve the abundance and size structure of smallmouth bass populations to provide a higher quality fishing experience.
- Increase the access to smallmouth bass fisheries, especially in streams.
- Protect water quality and quantity, and riparian habitat, and spawning habitat.

Secondary Objectives

- Maintain and improve selected fisheries for trophy smallmouth bass management.
- On an experimental basis, stock smallmouth bass to re-establish populations following large fish kills and to supplement natural reproduction.

Primary Objective 1. Improve the abundance and size structure of smallmouth bass populations to provide a higher quality fishing experience.

The current creel limit on bass serves an important role in many fisheries, but other alternatives could have added benefits. The current creel limit, which includes other black basses, is 5 bass per day and was established in 1997. In heavily fished waters, the current regulations limit harvest each trip, basically distributing the total harvest among more anglers. However, many anglers would like to see bigger bass available for harvest and for higher catch-and-release rates. A creel limit of 5 bass cannot improve the size of fish in heavily fished populations. Length restrictions such as minimum size limits and protected length ranges (slot limits) can increase the size distribution and abundance of bass in these circumstances. Across the nation length restrictions have been used to maintain favorable fish populations and quality fishing (Noble and Jones 1993). These successes include many smallmouth bass fisheries in rivers and streams (Fajen 1975, 1981; Paragamian 1984; Lyons et al. 1996), as well as lakes and reservoirs (Marinac-Sanders and Coble 1981; Hoff 1995; Slipke et al. 1998).

<u>Stream Fisheries</u>

In a recent study of Tennessee's riverine smallmouth bass populations, TWRA biologists examined effects of a variety of length restrictions on the average smallmouth bass fishery using computer modeling software (Fiss et al. 2001). The goal of this research was to identify length restrictions that would increase the number of bass in the population that were in the 12- to 15-inch length range. Growth rates did vary among riverine populations but mortality rates were far

more important than growth rates in determining the most effective length restrictions. Populations that suffered high mortality rates due to natural causes did not respond favorably to length restrictions. Likewise, populations that were not experiencing high mortality due to fishing also did not respond well to length limits. However, when natural mortality was low and fishing mortality was moderate to high, there was potential to improve the quality of the fishery using length restrictions (Fiss et al. 2001).

Minimum length limits of 10, 12, 14, and 16 inches and slot limits of 12-14, 12-15, and 14-17 inches were compared to the current "no length limit" regulations for stream populations (Fiss et al. 2001). Under conditions where length limits were effective, increasing higher minimum length limits protected more bass and thereby increased the abundance of quality fish. However, higher length limits (16 inches and greater) and the reduction in pounds of fish harvested may be more than the average angler is prepared to accept. After balancing these two factors it was apparent that a 14-inch minimum length limit would be an appropriate regulation to improve the quality of riverine smallmouth bass fisheries. The slot limits that we examined were not better than length limits due to a combination of survival and growth factors.

Slot limits are generally best used when population parameters are density dependent (for example, growth or survival could be inversely related to the abundance of bass in a population). There is no evidence to assume density-dependent factors (for example: poor condition due to over-crowding) will effect riverine smallmouth bass populations (Van Den Avyle and Hayward 1999). However, if TWRA managers determine that these populations are affected by density-dependent factors, we will consider slot limits.

A majority of stream anglers surveyed have supported minimum length limits, and typically more anglers are in favor of minimum lengths of 14 inches or greater, compared to those anglers that support 10 to 12 inch minimum length limits (Table 1). With the computer modeling in hand and a sense of public support, the next step is to experiment with a 14-inch minimum length limit on specific riverine smallmouth bass fisheries.

Stream Strategies:

1) Identify candidate waters for experimental regulations based on perceived high fishing pressure.

2) Implement 14-inch minimum length limits on smallmouth bass in the selected waters, and stress the enforcement of these regulations.

3) Monitor these waters to determine the effectiveness of regulations. Expected results are:
    a. Increased abundance of smallmouth bass between 11 and 14 inches.
    b. Angler satisfaction > 75 %

4) If monitoring suggests that the condition of fish is declining due to crowding, then the minimum length limit will be replaced by a slot limit. If a slot limit cannot improve the fishery then we should remove all regulations.

Reservoir Fisheries

Most established minimum length limits protect fish to age-4, allowing them to reach reproductive maturity. Length limits also work to protect fish to sizes preferred by anglers, allowing them to catch more fish (Hoff 1995). High rates of catch and release by reservoir smallmouth bass anglers suggest that they are currently much more interested in catching fish than taking them home to eat. Studies suggest that coolwater species such as smallmouth bass are more susceptible to post-release mortality, particularly fish released from bass tournaments (Hartley and Moring 1995). Harvest restrictions aimed at controlling population losses due to fishing mortality (both harvest and post-release) will optimize catch rates and size structure for reservoir smallmouth bass populations.

Growth rates for reservoir populations were much higher than those observed in riverine populations (Figure 2). Consistent growth rates mean that fishing mortality is more important in determining the appropriate length limits in reservoirs. Moderate to high angling mortality coupled with fast growth rates observed in southeastern reservoirs suggests that length limits are the best management option for most smallmouth bass in Tennessee reservoirs (Slipke et al. 1998). Management for quality smallmouth bass fishing will be accomplished using size limits $\leq$ 18 inches. Waters with potential for trophy fishing will be managed with minimum length limits of 20 inches or wide, high-end PLRs (slot limits). Daily creel limits will be set to maintain high release rates and may be different than those for the other black bass species. Managing for large fish in select locations ensures that Tennessee waters with exceptional recruitment and growth potential will sustain the state's national reputation for its smallmouth bass fishing.

Reservoir Strategies:

1) Maintain adequate numbers of fish $\geq$ age-4 in the population. Use optimum harvest restrictions to protect fish to larger sizes where growth potential exists or densities are low.

2) Continue to monitor success of current length restrictions through electrofishing and creel surveys. Expected results are:
    a. Increase abundance of smallmouth in the mid size ranges (11 – 16 inches), depending on the regulation on that reservoir.
    b. In waters with trophy potential, increase abundance of smallmouth bass over 18 inches.
    c. Angler satisfaction > 75 %

Primary Objective 2. Increase the access to smallmouth bass fisheries, especially in streams.

Access to fishing locations is mostly a problem for stream fisheries. Access to reservoir populations is provided by public boat ramps. Although ramps can be crowded at times, all anglers have equal opportunity to use these access areas. In contrast, there are a number of issues that affect access to stream fishing. Nearly all smallmouth bass streams are located on private property. Wade fishing is by far the most effective means to fish for smallmouth bass, but to do so requires anglers to walk on private property. Landowners routinely permit anglers

to fish these waters. However, there appears to be an increasing trend towards exclusion and fewer anglers are not aware of the proper protocols to gain access. Also many landowners and anglers are not aware of their legal rights and liabilities. This confusion impedes the angler's ability to obtain access privileges. On larger rivers, where anglers can usually float without getting landowner's permission, fishing is limited by the number of accessible parking and launching sites on the river.

Many anglers just need to know where to find smallmouth bass streams. This information can be interpreted from a number of TWRA reports, however this process is not practical. There is definitely a need to consolidate and distribute this information.

Strategies:

1) Biologist will identify navigable waters that have smallmouth bass fisheries potential and inventory existing access points for canoes or small boats. Given the condition and locations of these access areas, a prioritized list of access sites that need to be acquired or improved will be developed for each fishery.

2) Bridge crossings are prime locations for canoe access and bank fishing access. TWRA will review proposed bridge construction plans and request access areas on important fisheries.

3) To educate and improve relations between landowners and wading anglers TWRA will publicize the legal rights and liabilities of landowners and recommend a respectful way for anglers to use an access privilege. This information will be included in the fishing guide and distributed in media outlets that will reach rural landowners.

4) TWRA will explore legislation to allow fishing access within stream channels of waters intersected by public highways or explore legislation to create easements for fishing (and habitat protection).

5) If the above strategy is not accomplished, then TWRA, with the help of the Tennessee Wildlife Resources Foundation and other funding mechanisms, should purchase available stream corridors for fishing access.

6) Finally, TWRA will develop a map for distribution and a web site that shows the smallmouth bass fisheries and access areas.

Primary Objective 3. Protect water quality and quantity, riparian habitat, and spawning habitat.

Streams

The protection of riparian habitat, and water quality and quantity are the keys to thriving smallmouth bass fisheries in Tennessee. Without habitat protection and adequate water supplies, no amount of fisheries management effort can sustain smallmouth bass fisheries. State and federal agencies such as the Tennessee Department of Environment and Conservation (TDEC) and the National Resource Conservation Service (NRCS) are striving to protect stream and reservoir habitat. This is a difficult task that will require support from landowners, watershed councils, and TWRA. The following strategies were developed for all streams in TWRA's strategic plan, and they are applicable for the conservation of smallmouth bass habitat.

Stream Strategies:

1) Protect stream riparian zones through purchase, lease, or easements from willing landowners.

2) Involvement by TWRA fisheries staff in U.S. Department of Agriculture conservation programs to enhance and preserve riparian habitat. Especially, partner with NRCS in their habitat enhancement initiative.

3) Review all state and federal permits for aquatic habitat alterations.

4) To facilitate riparian habitat and water quality enhancements under the proposed Fishable Waters Act, TWRA should provide and/or dedicate personnel to review Fishable Waters Strategic Plans and assist local watershed councils, and the NRCS in plan preparations.

5) Support initiatives to create a stream mitigation bank, similar to the wetlands bank, and use the funds to acquire and protect new habitat.

6) Distribute "Warmwater Streams a Resource Worth Protecting" which is a video for general audiences that informs people about streams and habitat protection. Videos should be made available to anyone that will show the video.

7) Publish and distribute an educational pamphlet about proper stream stewardship to landowners and public planners. Coordinate these efforts with NRCS, and County Extensions Services, or other outlets that serve rural landowners.

8) Conduct 5 riparian conservation projects, including one major project in each TWRA region, by 2006. Projects should demonstrate the value of best management practices (BMPs).

9) Explore legislation to create conservation easements for habitat protection (and fishing access).

10) In each region, the Agency should be represented in at least one watershed council to address water quality and quantity issues in watersheds.

11) Provide updates to TDEC's surface water classifications (trout, wild trout status**,** etc.) as requested by TDEC.

12) Work with TDEC to protect instream flows and include sustained minimum flows for aquatic life in Tennessee's Water Quality Standards.

Reservoirs

Tennessee has an abundance of reservoir smallmouth bass fishing opportunities, but there are limits on carrying capacity and growth for each reservoir. Some lakes are able to produce high numbers of fish, but growth and mortality limit the abundance of large fish. TWRA managers recognize these limitations and plan their management strategies for smallmouth bass accordingly with an eye toward what the public desires. Habitat enhancement by placement of physical structure in lakes and reservoirs has proven effective in increasing available spawning habitat, yet the effects on the fishery are still unknown (Hoff 1991; Bulow, et al. 1998). Monitoring must be conducted on water quality and quantity to optimize the productivity of the fishery on each reservoir. The management challenge is to identify fixable problems related to habitat and annual spawning production.

Reservoir Strategies:

1) Monitor water quality and reservoir productivity in partnership with U.S. Army Corps of Engineers and TVA.

2) Request that reservoir regulators stabilize spring water levels to enhance spawning potential.

3) Cooperate with reservoir regulators to promote watershed stewardship.

4) Increase available spawning area by adding artificial structures (spawning benches).

Secondary Objectives

Secondary Objective 1. Maintain and improve selected fisheries for trophy smallmouth bass management.

Stream Fisheries

Currently two riverine fisheries have a 20-inch minimum length, the Pigeon River and Little Pigeon River. In both cases this regulation was established to protect larger fish that were already present in the population. A greater challenge will be to produce larger bass in an average population where big fish are less common. Many of Tennessee's streams have the potential to grow smallmouth bass to a maximum length of about 20-22 inches. Depending on the angler and the river in question, trophy bass are 16 to 20 inches in length. The goal of trophy management in riverine bass fisheries would be to increase the abundance of bass over 16 inches in the population.

Trophy management in streams has real costs for some anglers and should be approached cautiously. The use of high length limits, such as a 20-inch minimum length limit, drastically reduces harvest because relatively few fish in these populations actually reach 20 inches in length. For this reason we should have high levels of local angler support before adding additional trophy smallmouth bass regulations. It must be understood by all that even when ideal conditions appear present for trophy management, our expectations may not be met. However, a benefit of trophy management by means of a 20-inch minimum length limit is that even if the fishery falls short of the trophy goal, the number of quality (12-15 inch) bass is likely to increase, thus addressing our primary objective. High slot limits (for example, PLR 14-18) may also have potential for trophy management on streams, however they will only work if there is low to moderate harvest allowing consistent recruitment to the minimum protected length.

Stream Strategies:

1) Conduct angler attitude surveys to determine support for trophy smallmouth bass fishing.

2) Maintain current regulations and monitoring plans for the Pigeon River and Little Pigeon River.

3) Identify candidate waters for experimental trophy regulations.

4) Monitor these waters for at least two years to establish baseline conditions.

5) Implement a 20-inch minimum length limit with a one fish creel limit or a high slot limit (for example, PLR 14-18 inch)with a one fish creel above the slot, and stress the enforcement of these regulations.

6) Monitor these waters to determine the effectiveness of regulations based on abundance of large smallmouth bass. The expected results are:

   <u>20-inch minimum length limit</u>

   a. Increase abundance of smallmouth bass in the 16-20 inch size range
   b. Angler satisfaction > 75 %

   <u>High Slot Limit</u>

   a. Increase abundance of smallmouth bass within the protected slot. For example, an effective PLR 14-18, should increase the abundance of smallmouth bass in the 14 to 18 inch size range.
   b. Angler satisfaction > 75%

<u>Reservoir Fisheries</u>

In recent years, the angling public and fishery managers have expressed concern over declining fishing quality which has precipitated recent changes to fishing regulations on select lakes. Current levels of fishing pressure on many Tennessee reservoirs necessitate harvest restriction to maintain fishing quality. Certain waters have historically had higher densities of large fish and it is TWRA's objective to preserve the trophy potential for these smallmouth bass fisheries. Minimum length limits of 20 inches and wide, high-end slot limits are aimed at increasing

abundances of larger fish. Wide slot limits like the one at Dale Hollow are at the upper range for large fish management and are appropriate only when recruitment, growth, and fishing mortality are high. Very restrictive creel limits (i.e. 1 or 2 per day) are also aimed at maintaining high release rates and reducing fishing mortality.

Reservoir Strategies:

1) Monitor shifts in abundance, age and size structure of smallmouth bass populations in response to regulations.

2) Identify other bodies with trophy potential and impose new regulations only where high or increasing levels of fishing mortality warrant.

3) Monitor effects and angler satisfaction where trophy size limits are in effect.

4) Continue to sample public opinion on current management for trophy smallmouth bass fisheries.

Secondary Objective 2. On an experimental basis, stock smallmouth bass to re-establish populations following large fish kills and to supplement natural reproduction.

Occasionally a fish kill will remove smallmouth bass from large reaches of rivers. If there are barriers to immigration of smallmouth bass from adjacent reaches then it may be necessary to stock smallmouth bass into the isolated reach.

In streams, stocking might be used to supplement natural reproduction. Biologists suspect that chronic spawning failures are limiting the abundance of smallmouth bass in some of the rivers that have been impacted by flooding or excessive sedimentation. Although stream stocking of smallmouth bass has not been particularly successful, relatively little research has been conducted (Funk and Fleener 1974). Therefore additional experimentation may be warranted.

In reservoirs, spawning success is driven by factors such as, water quality, temperature, and water level fluctuations. Little research has been done on smallmouth bass specifically, but generally, black bass stocking has been unsuccessful due to high incidence of predation on stocked fingerlings. Raising black bass to larger sizes in hatcheries is expensive and difficult as growing fish become cannibalistic in hatchery ponds. However, recent research has suggested that stocked largemouth bass may recruit in reservoirs if densities of naturally spawned bass are extremely low and early spring stockings are conducted at high densities in a localized area (St. John and James 2000). Similar experimental stockings should be made to evaluate this potential with smallmouth bass in selected reservoir areas where habitat is not limiting.

About 30 years ago, TWRA commonly stocked smallmouth bass into streams. Whether or not these stockings were successful was not well documented, probably because fish were stocked at small sizes and could not effectively be marked. Since that time, a number of technological advances have made it easier to track the success of stocking experiments. TWRA currently uses oxytetracycline (OTC) to tag fingerlings at the hatchery, which chemically marks the bony

structures in fish. The mark can be viewed under ultraviolet light and allows biologists to determine whether or not recaptured fish are of hatchery origin.

Advances in the field of genetics have determined that not all populations are necessarily the same. A fish population found in one river may be very unique, compared to populations in neighboring rivers. Geneticists warn that stocking of fish from one population into a different population could result in detrimental effects (Philipp et al. 1983). The greater the differences are between populations, the more likely that unwanted results could follow from mixing the populations. Ideally, a smallmouth bass stocking program should use brood fish from the same watershed or brood fish from a similar population.

Strategies:

1) Identify the existing genetic variability in smallmouth bass populations across the state. This information will allow managers to collect brood fish from the proper sources.

2) Every time smallmouth bass are stocked, hatchery managers will use OTC to mark all smallmouth bass stocked and biologists will conduct surveys in subsequent years to evaluate the effectiveness of the stocking.

3) Supplemental stocking of fingerling smallmouth bass in rivers and reservoirs will be conducted on a strictly experimental basis. TWRA will stock smallmouth bass at a rate of 1000 fingerling bass per mile in large rivers, and 500 per mile in smaller streams. Reservoirs should be stocked at a rate of $\geq$ 10 per acre of designated study acreage.

Research Needs

TWRA is committed to meeting the above objectives given the available strategies and our current understanding of how smallmouth bass interact with their environment. However there are many information gaps to be filled. By addressing the following research and development needs, biologist will be able to manage smallmouth bass now, and in the future.

- Determine the quantity of instream flow required to support the smallmouth bass' aquatic community.

- Measure exploitation rates in streams to demonstrate where regulations are needed.

- Conduct genetics research to determine if smallmouth bass populations are genetically isolated enough to warrant special management considerations.

- Conduct research to better understand the effects of environmental variables affecting recruitment of smallmouth bass in riverine and reservoir habitats.

- Conduct research to determine the effects of post-release mortality on smallmouth bass populations.

- Determine the effect of reservoir shoreline habitat enhancement structures on smallmouth bass recruitment.

- Develop new techniques for increasing the production of smallmouth bass fingerlings in TWRA fish hatcheries.

- Improve monitoring techniques for smallmouth bass populations to obtain repeatable and accurate estimates of stock structure and abundance.

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Glossary

Catch: Number of fish captured by angling, including both harvested and released fish.

Condition: The weight of individual bass relative to the average weight of bass of the same length. Fat and healthy bass are said to be in good condition. Skinny or sick bass are in poor condition. There are numeric indices used to quantify condition, e.g. relative weight (Wr, see below).

Creel Survey: A survey designed to estimate the number of anglers, number of hours fished, catch rate, and harvest rate at a particular fishery. Creel surveys are conducted annually on most reservoirs and occasionally on streams.

Exploitation: Percent of fish removed from a population by angling.

Growth: Change in fish length or weight over time. We typically use change in length to describe growth in bass.

Harvest: Number fish captured and kept by the angler, does not include released fish.

Mortality: Removal of fish from the population by death, either by natural causes (natural mortality) or harvest by anglers (fishing mortality). Total mortality is the combination of both factors.

Population: For the purpose of this report a population is a group of smallmouth bass that is managed as a single group of fish. Individuals in this group have the same mortality, growth, and recruitment rates. In most cases all the bass in a given reservoir or stream would be considered to be in the same population.

Protected Length Range (slot limit): Length regulations that allow anglers to harvest fish above and below a specified length range, but fish within the protected range may not be harvested. For example, a 14-18 inch PLR protects fish 14 to 18 inches in length. Angler anglers may harvest fish that measure 14 inches or less and they may harvest that measure 18

inches or more.

Proportional Stock Density (PSD): An index that expresses the proportion of quality-size (11 inches and larger) to stock-size (7 inches and larger) smallmouth bass within a population. Values can range from 0 to 100, with values around 40– 70 being most desirable for smallmouth bass populations. Extremely low or high values can indicate unstable populations.

Recruitment: The number of bass that a population produces (spawns) that live at least one year. Recruitment can be indexed by the relative number of age 1 bass captured during standardized surveys from year to year.

Relative Stock Density (RSD): Similar to PSD (above), this is an index that expresses the proportion of bass of a particular length to stock-size (7 inch) bass in the population. For example RSD14 would be calculated as the number of 14-inches or larger bass divided by the number of stock-size (7 inches or larger) bass, multiplied by 100. RSD values could range form 0 to 100. Desirable values depend on the given length of interest and the management objective.

Riparian: Pertaining the land immediately adjacent to a stream or reservoir. Although not directly used by smallmouth bass, stream riparian zones are critical habitat primarily because they keep water temperatures cool by shading and they filter out sediment and other pollutants.

Size structure: relative number of fish of different sizes in a population.

Wr (relative weight): weight of an individual fish divided by the average weight of fish of the same length multiplied by 100. This index provides a numeric description of a fish's plumpness (Is the fish fat or skinny?).

Table 1. Stream angler activity and support for new regulations from the phone surveys conducted by Jakus et al. (1998, 1999) and Stephens et al. (2001). Data reflect activity from March 1 to August 31 each year.

	1995	1996	1997	1998	2000
Number of trips/season	11.9	8.0	8.5	6.4	12.0
Percent targeting bass species	37.4	37.1	43.0	NA	NA
Average number of black bass caught per trip	4.3	4.4	3.5	3.4	3.9
Average bass number of black bass harvested per trip	0.5	0.2	0.3	0.6	0.4
Size limit for black bass	59.1	73.7	61.5	78.5	82.4
Support	22.6	14.3	27.5	14.3	11.7
Oppose	16.4	12.0	11.0	5.9	3.8
No opinion	1.9	0.0	0.0	0.0	2.1
Other					
Of those supporting a size limit					
Percent that prefer each size limit:	NA	NA	NA	NA	27.9
10 - 12 inches	NA	35.9	40.6	42.1	21.9
12 inch		NA	NA	NA	2.5
13 inch		37.2	39.4	33.8	20.0
14 inch		10.0	8.7	15.0	10.9
15 inch		4.7	6.8	3.9	3.6
16 inch		NA	NA	NA	2.3
18 inch		NA	NA	NA	0.9
19 inch		7.5	0.0	1.8	
Other	NA	4.7	4.6	3.4	
Don=t know					
		NA	NA	62.1	81.7
Protected length range (slot limit) for bass				32.3	13.7
Support					
Oppose					

NA = not asked

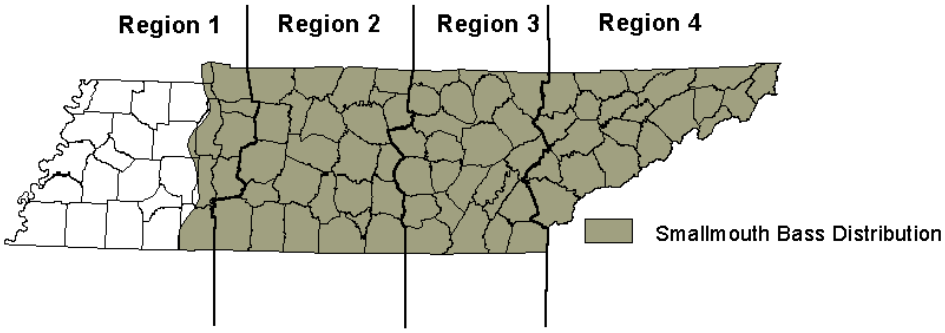

Figure 1. Distribution of smallmouth bass in Tennessee.

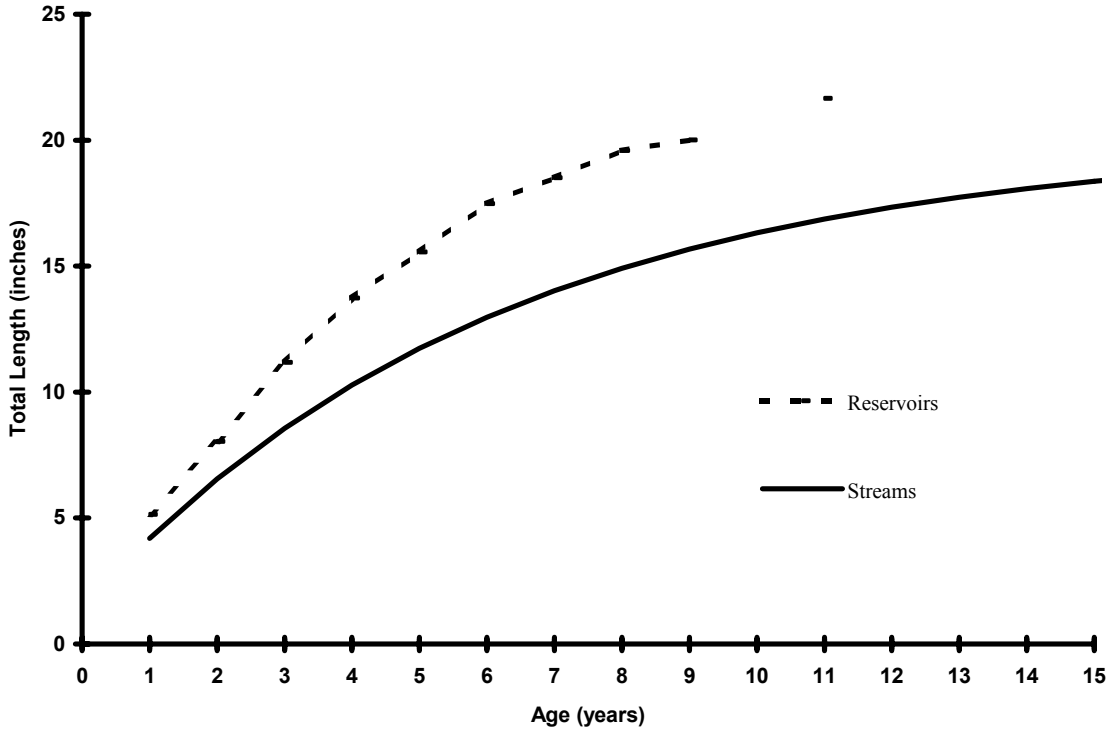

Figure 2. Mean length at age for smallmouth bass in Tennessee reservoirs (dashed line; unpublished data) and streams (solid line; Fiss et al. 2001).

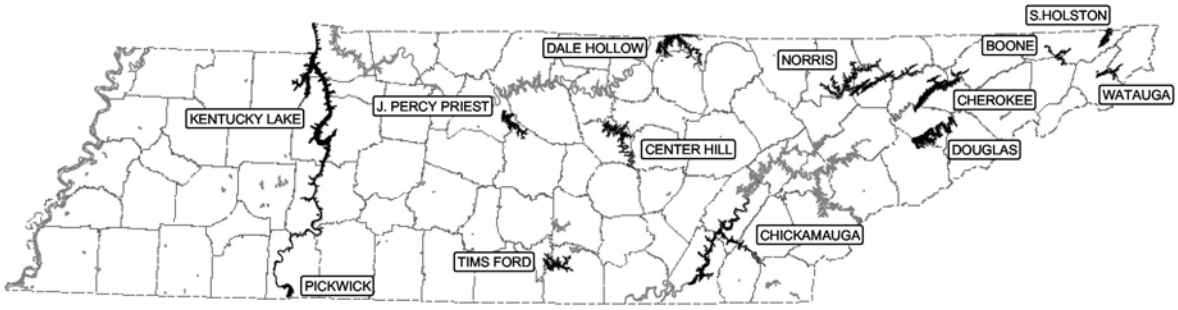

Figure 3. Map showing major reservoir fisheries for smallmouth bass. Dark shading indicates more than 1,000 angler hours per year are expended by anglers targeting smallmouth bass (Malvestuto and Black 2002).

Appendix A

Public comments on Tennessee's Smallmouth Bass Plan

We received 43 written comments on the smallmouth bass plan, 24 identified themselves as stream anglers, 13 as reservoir anglers, and 7 commented on the entire plan.

Stream anglers overwhelmingly supported all primary and secondary objectives. Their comments supported the use of length limits and reduced creel limits to promote improved fisheries. Their most common criticism of the plan was that proposed regulations were not restrictive enough. Many requested statewide length restrictions. They appreciated the need for water quality and riparian protection. Local issues included requests for bass stocking and additional trophy regulations, typically on larger rivers.

Most reservoir anglers supported the plan. Reservoir anglers that did not support the plan were most concerned with the use of trophy management, mainly because they felt it would not be compatible with tournament angling. Common comments included requests to restrict commercial fishing and tournament angling, and better management of reservoir water level to accommodate bass.

The following is a summary list of suggestions provided by the public. The number in parentheses is the number of people that made that comment.

1. Reduce the creel limit on smallmouth bass. (10)
2. Support for a minimum length limit for smallmouth bass. (10)
3. Support for efforts to protect streams including water quality and riparian zones. (7)
4. Support for trophy management using size limits in rivers and reservoirs. (7)
5. Stock smallmouth bass in streams. (5)
6. Limit or regulate bass tournaments. (4)
7. Do not support TWRA's current trophy management in reservoirs or think the plan will create too many more trophy waters. (4)
8. Need more access to streams. (3)
9. Improve smallmouth bass fishing on Pickwick Reservoir using length restrictions. (3)
10. Lobby dam operators to provide stable springtime water levels. (2)
11. Stop commercial fishing in smallmouth bass habitat. (2)
12. Increase enforcement of fishing and littering laws to promote more public access. (2)
13. Reduce public access to support private property rights. (1)
14. Promote volunteer catch and release fishing. (1)
15. Improve reservoir spawning habitat (1)
16. Protect mature smallmouth during spawning season. (1)
17. Do not support reduced harvest on streams. (1)
18. Too many jet skis. (1)
19. Request more angler involvement in achieving plan goals. (1)